Risk Factors for Late Onset Hearing Loss: Extended Stay in NICU

Left undetected, hearing loss in infants can negatively impact speech and language acquisition, academic achievement, and social and emotional development. If detected early, however, morbidity can be diminished and even eliminated through early intervention services. This fact sheet reviews some of the risk factors associated with hearing loss that accompany an infant's extended stay in a neonatal intensive care unit (NICU).

Very Low Birth Weight (<1,500 grams)

For children with very low birth weight (<1,500 grams), the risk for sensorineural hearing loss increases as the birth weight decreases. Children weighing less than 3,000 grams are also at an increased risk for hearing loss compared to children weighing more than 3,000 grams.

Ototoxic Drugs

Ototoxic drugs can cause toxic reactions to structures of the inner ear that can result in loss of hearing and/or balance. Some examples of ototoxic drugs are:

- **Aminoglycoside** antibiotics may be ototoxic when administered to a child or to the fetus when administered to a pregnant woman. Sensorineural hearing loss results from damage to the hair cells of the vestibular and cochlear organs (components of the inner ear). Individuals with a very rare specific mutation in mitochondrial DNA (A1555G) are particularly susceptible to the ototoxic effects of aminoglycosides. For individuals with this mutation, even one dose of an aminoglycoside can cause hearing loss. The following are common aminoglycosides:
  - **Streptomycin** damages the vestibular portion of the inner ear and, with continued treatment, may lead to measurable hearing loss and complete deafness
  - **Neomycin, Kanamycin, and Amikacin** cause severe cochleotoxic effects when given in large doses orally or in colonic irrigation for intestinal sterilization
  - **Viomycin, Vancomycin, Gentamicin, and Tobramycin** cause cochlear and vestibular toxicity
- **Salicylates** are used to reduce pain and fever (aspirin, choline salicylate, magnesium salicylate, sodium salicylate, salsalate). They can be taken orally or rectally and different types are available both with and without a prescription. When given in large doses, salicylates may cause reversible hearing loss and tinnitus (ringing in the ears). The magnitude of hearing loss is proportionate to serum levels of the salicylate.
- **Quinine** is taken orally and is used to treat malaria and nighttime muscle cramps. One side effect of the drug is permanent hearing loss. When quinine is taken by a pregnant woman during the first trimester it may result in severe inner ear abnormalities in the fetus. Quinine is contraindicated for use during pregnancy except for purposes of treating malaria.

Low Apgar Score (0-4@1min or 0-6@5min)

Infants with low Apgar scores are at an increased risk for hearing loss because of their existing condition or because of consequential medical procedures.

Postnatal Infection Associated with Sensorineural Hearing Loss (Sepsis, Bacterial Meningitis)

Bacterial meningitis and sepsis are severe invasive diseases. These infections can lead to sensorineural hearing loss. In addition, antibiotics used to treat the infection may be ototoxic (refer to Ototoxic Drugs, above).

Hyperbilirubinemia Requiring Exchange Transfusion

Hyperbilirubinemia, or jaundice, occurs in 50%–60% of all newborns. It is often without consequence, but it can cause damage to the nervous system if severe. In cases of severe hyperbilirubinemia, the auditory neural pathways (cochlear nuclei of the brain stem) and/or the cochlea may be affected, leading to neonatal hearing loss. Infants with hyperbilirubinemia at a serum level requiring exchange transfusion should have additional auditory brainstem response (ABR) testing.

Mechanical Ventilation for >5 Days

By the time an infant has been put on mechanical ventilation, he/she may have already sustained a high level of oxygen deprivation. A lack of oxygen can accelerate the deterioration of the sensory cells of the inner ear. Mechanical ventilation could also indicate other possible problems associated with hearing loss, such as bronchiopulmonary dysplasia or persistent pulmonary hypertension.

Condition at Birth Requiring Use of Extracorporeal Membrane Oxygenation (ECMO)

Infants who necessitate ECMO may suffer levels of oxygen deprivation sufficient to cause damage to the sensory cells of the inner ear. About a quarter of ECMO graduates develop sensorineural hearing loss. Roughly half of ECMO graduates with sensorineural hearing loss have a progressive type of loss, which reinforces the importance of follow-up screening.

References

1. Merck Manual of Diagnosis & Therapy. Section 7. Ear, Nose, & Throat Disorders. Chapter 85. Inner Ear. http://www.merck.com/mrkshared/mmanual/section7/chapter85/85j.jsp (accessed March 7, 2006)
2. Van Naarden, K. and Decoufle, P. Relative and Attributable Risks for Moderate to Profound Bilateral Sensorineural Hearing Impairment Associated with Lower Birth Weight in Children 2 to 10 Years Old. *Pediatrics*. 1999;104;905-910.
3. Nicolosi L, Langella L, Krzyxztofiak A, Ticca F. Streptococcus pneumonia meningitis in children. Case records 1985-2003. [article in Italian] *Infez Med*. 2004 Dec;12(4):252-258.
4. Oysu C, Aslan I, Baserer N. Incidence of cochlear involvement in hyperbilirubinemic deafness. Ann Otol Rhinol Laryngol. 2002. Nov;111(11):1021-5.
5. Fligor BJ, Neault MW, Mullen CH, Feldman HA, Jones DT. Factors associated with sensorineural hearing loss among survivors of extracorporeal membrane oxygenation therapy. Pediatrics. 2005 Jun; 115(6):1519-28.
6. North Carolina Late Onset Hearing Loss Detection and Intervention, http://www.ncnewbornhearing.org/LateOnset/Risk%20Factors.htm (accessed March 7, 2006)
7. DHHS, Agency for Healthcare Research and Quality, July 2000. no. 237. Apgar scores found to be useful in assessing premature newborns, http://www.ahrq.gov/research/jul00/0700RA5.htm#head4
8. Usami, S. et al., Sensorineural Hearing Loss Associated with the Mitochondrial Mutations. Adv. Otorhinolaryngol 2000; 56:203-211
9. Subcommittee on Hyperbilirubinemia, Clinical Practice Guideline. Management of Hyperbilirubinema in the Newborn Infant 35 or More Weeks of Gestation. *Pediatrics*. 2004 July. 114(1):297-316.
10. Cash, Sheryl. Guideline Offers Direction for Prompt Diagnosis, Treatment of Hyperbilirubinemia. AAP News, American Academy of Pediatrics, July 2004.

For more information about infant hearing loss, please visit our website: www.doh.wa.gov/ehddi.

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